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ABSTRACT

The process that Catonsville Community College (Maryland) went through in moving from a copper to a fiber network is outlined. The discussion addresses the following: describing the need in real terms; building consensus for the project; gaining support by college management; justifying the need for consultant support; writing the request for proposal (RFP) for the consultant; working with the consultant and generating a final report; preparing an RFP for fiber installation and evaluating responses to the RFP; selecting the vendor(s); installation/integration; and possible synergy for the future. As background, general information is provided on the college and on computer services staffing. Computing and data communications capability at the beginning of the project is outlined. Problems with the initial system and capabilities are identified. Fifteen future campus data communications needs are listed. Nine project cautions are offered with respect to future data communications scenarios. The paper concludes with a list of future uses of the new network suggested by industry developments. (MAS)

Designing And Integrating A Fiber Optic Network With An Existing Copper Network

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Purpose

Most colleges and universities have been developing computer networks for years, in fact, most were started well prior to being able to economically justify fiber media, agree on the type of fiber to be installed or have any flexibility in the installation of various fiber options. Early use of fiber was fraught with concern about the application of standards or the lack thereof and a fear that what was purchased now would be obsolete as the industry matured.

So.......we continued to install copper and as the industry gradually standardized and as the direction became focused, so did our view of the future. This view required high bandwidth capabilities that copper backbones were not capable of providing. And we found college administrators willing to participate in a discussion about this "infrastructure thing".

So.......many of us find ourselves with well-developed and highly connected copper networks that need upgrading.

I would suggest also that most of the folks in this room today are not flush with large budgets. It is really a pleasure to present these thoughts to you as I feel I am with a group of folks who have the same budget problems - no money at all! We have high level administrations who want world wide web home pages (because it meets a political need) and client-server solutions (because they know it will save mountains of money) and yet the well is dry when funding is requested for fiber infrastructure and associated equipment.

What can be done? My plan is to take you through the process that my college went through in moving from a copper to a fiber network. My thoughts include:

- describing the need in real terms
- building consensus for the project
- gaining support by college management
- justifying the need for consultant support - writing the RFP for the consultant
- working with the consultant and generating a final report - preparing an RFP for fiber installation and hubbing equipment - evaluating the responses to the RFP
- selecting the vendor(s)
- installation/integration
- possible synergy for the future

I also will present some personal views of how things can be done and where I think we should go as directors of computing services. Some of the ideas might be a little radical and controversial. Later on in the presentation, I'll ask for questions and comments and would really appreciate your critique.

Before I move into the meat of the presentation, I think that its appropriate for you to understand what my college is all about, from a general information viewpoint, what was our computing capability at the beginning of the process and what staffing did I have available. .sp

General College Information

Catonsville Community College was founded in 1956 and has grown to a institution with approximately 40,000 head-count students annually equating to about 10,500 FTE's. It is a comprehensive college with a significant commitment to the transfer student but with a very strong technical component. For example the Ford and GM ASEP training programs are on our campus; we have a large CIM and numerically controlled machine shop lab; we have an extremely large CAD teaching facility for Autocad, Cadkey, VersaCad and PC-Cadam and we operate a large JTPA program on campus.

Our campus occupies about 130 acres immediately west of Baltimore City and if you have even visited Baltimore's Harborplace, our campus looks down on the main harbor area from a large plateau about nine miles west of the harbor. The campus includes 21 buildings representing several architectural periods including an 18th century caretaker's house (now student activities) and an even earlier mansion house that has been fully restored and is on the National Register of Historic Places.

The annual budget for the college stands at $45 million with about $1 million allocated to Computer Services and computer purchases. There are 700 full-time employees and a total of about 3000 W2's issued annually including part-time employees, adjunct faculty and student workers.

Computer Services has reported to the Dean of Administration for the last three years after a stretch of about 10 years reporting to the Dean for Institutional Advancement. The Computer Services staff totals 23.

Community colleges in Maryland are funded by both the state government and the local counties resulting in rather autonomous institutions with minimal centralized state control i.e. plans are formulated, purchases are made and checks generated on the local campus. .sp

Computer Services Staffing

I have been at Catonsville for 14 years. One of my most prideful accomplishments is in developing a competent staff. They are experienced. My management staff consisting of managers of systems development, technical support, PC help center, data communications and networking and operations average 15 years each in the field.

In the data communications and networking area, I have a manager, a LAN administrator, 3 half-time communications specialists and a number of student workers. Also supporting this group is a UNIX analyst who is responsible for Netview, campus-wide LAN backups, Internet and MOSAIC development and special projects.

The remainder of the department consists of functions routine to data processing with the possible exception of a PC Help Desk that includes an automated trouble reporting system for PC hardware, software or data communications problems.

Back again to data comm, the staff over the last seven years is totally home grown. I have been fortunate in finding students who accepted the challenges of data comm and flourished. Many of them have gone on to much higher paying positions elsewhere but we have been fortunate to have them while we can. At this time, finally after years of requesting funding support, I can now offer living wages to these folks and we have stability in the staff - I'd stack them up against anybody's staff, anywhere.

A little farther on, I'll describe for you what our network looked like in the Summer of '93 when we began the upgrade process. No equipment including a large data PBX, the gear supporting nine remote sites, or our compressed video equipment has been installed by outside service providers. We have installed all of it ourselves including running 99 percent of campus cabling. All gear is self-maintained.

Combine the above with the natural drive and motivation of a young staff below the management level with a minimum of ego problems and an orientation to teaming in solving problems and moving ahead and you will hit upon one of the major reasons for our success with this project. In short, mention "fiber" to these folks and it was all I could do to hold them back!

Computing And Data Comm Capability At The Beginning Of The Project

In order to understand where we wanted to go, it is useful to understand where we have been. The following brief description of our computing and data communications capabilities in the Summer of 1993 sets the stage for our future direction.

- IBM 4381/T92, RS/6000, AS400 installed and networked to all workstations.
- Heavily committed to asynchronous (ASCII) data communications; three IBM 7171's are installed with 192 ports available.
- Links throughout campus to most of the 21 buildings and to most faculty and staff, the president (a heavy user), the deans, etc.
- Compressed video via T1 links to seven remote sites at other colleges scheduled and maintained by Catonsville.
- Student and financial data and an on-line library system available on the faculty/staff desk top for years.
- Six token ring LANs in use, each able to interconnect (after a fashion). Three Arcnet LANs installed with plans to upgrade them as funds become available. Token ring and Arcnet LANs connect to the IBM 4381 via NET3270. Total of 285 nodes are now connected to the college network via LANs at this time.
- Novell is the college standard for LAN communications.
- Netview/6000 being installed as the standard for network management.
- Infotron NX4600 data switch (character based) with 750 cross connects

- Infotron on-campus remote mode linked via fiber optic cable.
- Infotron remote node connected via T1 to Carroll Community College, Westminster, Maryland, with 100 connects.
- Coax installations include three IBM 3274's and one IBM 3174 for terminal support. (No pc's are attached via 3270 cards except for the two NET3270 LAN link gateways.)
- Many Sequel short haul multiplexors and Equinox T1 local multiplexors installed on campus.
- Many Astrocom coax multiplexors installed.
- Remote link to two other colleges via SNA at 19.2K.
- Remote link to two additional colleges at 9.6K.
- Linked to BITNET beginning approximately 1988.
- An NTI Meridian telephone pbx has been installed for about a year using only the copper wiring that existed prior to the install. Provides voice mail and data links for some terminals and PC's.
- Extensive campus-wide Email in use on the IBM 4381 and MUSIC/SP as the mail system platform with approximately 20,000 items/week.
- Remote links to five local high schools via 19.2 synchronous lines, each with 32 devices for student/faculty access.
- Remote dial-in service at 9600, 2400 and 1200.
- An AS400 installed with token ring and 16 async terminal connects.
- An RS6000 installed with token ring and 16 async terminal connects.
- Two ethernet LANs in MacIntosh labs not connected to the college network at this time.
- One Apple talk LAN in the College Press that is linked to the college network via individual serial connections from each MacIntosh on the LAN.

Did We Have A Problem?

More and more, it became obvious that the college had a problem, or better yet an opportunity. The pulse of the industry suggested exponential change. Multi-media was on everyone's mind. Connectivity was a necessity not only between users and the mainframe data store but also between individual users.

We dealt with the problems as best we could and built some solutions but they were not optimum. As we began to realize that computer services staff simply could not support many LAN servers located in various buildings throughout the campus, we hit on the collapsed backbone design as good for us. But how could we move in that direction by relying on thousands of feet of copper cable linking LAN servers to the computer center four buildings away.

It also became obvious that some of the cable that we had installed in conduits 10 years before was beginning to give us problems. In fact, on a day that registration was to begin in our gymnasium about

300 yards from the computer center, a key coax cable finally rusted away - literally. Charging into the breech, we alerted college management that the age of our connectivity infrastructure was such that they could expect many more occurrences in the future. But there was a way to solve the problem .... and what a way it was.

Developing Consensus For The Fiber Network Project

A candle hid under a bushel................

Fortunately, Catonsville has a nurturing environment for implementing technology. Support comes from the president and the dean level of management but in a supportive, and in some ways, reactive way. For self-starters, we have the option of creating our own destiny. We are strictly a "bottom up" college. Rarely do directives come from on high that we must comply with. This environment fosters creativity and encourages risk but it places responsibility for success or failure on the entrepreneurs.

Because of this management philosophy, a well-developed committee structure has evolved that fosters cooperation among staff and faculty. To get something done at Catonsville, the committee structure needs to be stroked. We thus began a process of involving the various computer- related committees in the fiber network definition, proposal writing, critiquing and in general, talking up the project around campus.

The committee structure consisted of:

TEAM - Technology in Education and Management and the "daddy" of committees. Other established and ad-hoc committees report to this group.

ACADEMIC COMPUTING - The part of computing that deals with student needs.

MANAGEMENT INFORMATION SYSTEMS - The part of computing that deals with college administrative computing needs.

DATA COMMUNICATIONS AND NETWORKING GROUP - A sounding board for developing the networks needed to service all constituencies.

NETWORK ADMINISTRATORS RESOURCE GROUP - A support group of LAN administrators who are really local office folks and provide the first line of support in maintaining college LAN's.

COMPUTER RESOURCE GROUP - A support group of key PC users who meet regularly to provide guidance to the Computing Help Center in their role of conducting user training, offering software assistance and providing hardware repair.

THE PRESIDENT AND HIS STAFF - Meeting both with and without the president, this group needs to be informed about opportunities and directions and if in agreement, will support additional work on a project with the objective of later funding it.

THE TRI-COLLEGE COMPUTING COMMITTEE - Catonsville exists as one of three community colleges in our county. This committee coordinates computing development and with the active participation of two members from the Board of Trustees, smooths the way for ultimate approval of funding by the Board.

THE BOARD OF TRUSTEES AND THEIR FINANCE COMMITTEE - It goes without saying that the objective of a project proposal is to win approval to proceed from the Board.

>From this interchange of ideas at various levels throughout the college by the end of about a six-month period, we were able to create a list of needs that a fiber optic network and associated electronic componentry was designed to satisfy. By inference, the list pointed out those future needs that would not be met if the project was not approved. .sp

Future Campus Data Communications Needs As Initially Defined

1. To move to the next level of connectivity. The college had reached a plateau where the use of current copper/twisted pair/ coax technology would not meet future bandwidth needs.

2. To develop an adequate connectivity infrastructure, without which the college will not be able to move into and take advantage of the newer technologies.

3. To create an environment that can support client/server as campus computing evolves in the future. We need to be able to choose the type of computing platform that best fits the application being considered.

4. To connect any PC to any other PC and to any other computing resource in the network including the 4381, the RS6000 and the AS400. To facilitate this interconnection seamlessly with no degradation in response time or complexity for the user.

5. To free up many campus conduits that have been filled with coax and twisted pair cables by replacing them with a fiber optic configuration. Opening the conduits results in eliminating the need to dig additional trenches (an expensive proposition) when enhancing the telephone connectivity or tv/video service is required.

6. To create/move toward a network where connectivity and network software is maintainable from a central source with a minimum of staff. Expanding networks around the campus with no or minimal linkage to central services creates a maintenance headache when the support organization is under staffed.

7. To continue to emphasize standards and network consistency as we have already done. This helps to simplify maintenance, network extension, bridging and routing.

8. To continue developing a technical support staff that is well trained and has adequate numbers of people necessary to support the college community in the use of the new technologies.

9. To control and monitor the network via network management system software (SNMP, NETVIEW, etc). A method needed to be available to be aware of problems before the users do and to diagnose problems once they are determined.

10. To provide routing connectivity for an Internet link as an extension to BITNET and to provide interactive support for users connecting to devices remote to main campus.

11. To provide a network that can be extended to individual classrooms as necessary from centralized wiring centers in each building.

12. To extend full LAN connectivity to Macintosh users and to those Mac users now connected to Ethernet and Appletalk LAN.

13. To be able to link LANs at remote sites and to integrate users and lan maintenance in a seamless environment. LANs at the two remote sites need to be fully connected to services on main campus both for access and maintenance.

14. To create an infrastructure that will be able to support links to two sister colleges for SNA, TCP/IP and IPX protocols. Users across the tri-college network should be provided with full capability to access any resource on any campus.

15. Position the college with an adequate fiber media installation that could connect anything to it without limits as technology changed, i.e. we wanted to change the electronics not what was in the ground!

Project Cautions

Research into possible future scenarios determined that whatever approach we chose needed to consider several cautions. We listed a few to keep us honest.

1. Implement fiber optics technology. Bandwidth needed to be expanded by a significant factor. Multi-media and CD ROM access required a level of bandwidth not supportable on copper. Fiber was the only option. Fiber would be an enabler/a facilitator. 2. Be cautious if committing to some of the newer approaches such as

ATM. Standards and industry direction are not yet firm. However, there may be ways to hedge against possible obsolescence by installing a media layer that would service the new technologies.

3. Use extreme caution in justifying voice and video over fiber for the distances required by the campus. This approach may seem the most modern but may not be economically justified.

4. Question any FDDI deployment to the wiring closet and reject outright any FDDI to the desktop. Seriously consider FDDI as a possible collapsed backbone medium as it provides high bandwidth yet requires only a minimum commitment to the technology.

5. Use fiber to connect remote LANs to central servers as a way to meet the objective of item 4.

6. Question the continued use/standardization of token ring and whether 16 MB token ring is the best topology and speed for local LANs.

7. What is the best product for linking LAN's to mainframe resources? Is NET3270 still the best and most economical method of linking LAN's to the 4381?

8. Should the college continue with Novell as the lan operating system of choice?

9. Is ethernet twisted pair the best network media for connecting the CAD labs and engineering? Ethernet seems to be the choice in the CAD/engineering world.

We Knew Where We Wanted To Go But ....

>From the presentation so far you can probably tell that we were on the way toward an approach. We were comfortable with our ideas and the more we discussed them, the more they were becoming reality in our minds.

But still we thought that a sounding board for our ideas from someone outside the college community would help assure us that the direction was correct and the college could hope to reap significant benefits from our plan.

A consultant could provide us with:

- Advice on fiber optic technology that we did not possess
- Compare and contrast different approaches
- Question the collapsed backbone strategy
- Help establish a fiber topology and fiber counts
- Act as a sounding board for our ideas
- Help sell the plan to management and others on campus
- Provide suggestions for the hardware RFP
- Provide insight into different vendor hardware offerings

The idea was tried on the president's staff and they supported it but there was one caveat. Minimal funding was made available (surprise). Actually this played into our hands because the network was to be our creation. We were looking for support and a critique not a nuts and bolts plan. We expected to prepare all requests for quotation as in fact, the first RFP that was generated was for the selection of the consultant.

The RFP suggested a "short-term" project as the only option. Included was a list of current capabilities as well as our view of the future. The RFP asked for a number of specific deliverables including a topology plan, fiber counts and equipment options. Formal presentations were also to be made at individual meetings of the president and his staff, TEAM and the Network Planning Group.

A copy of the consultant RFP is included in ATTACHMENT A.

RFP's were forwarded to 16 potential consultants. Eleven responses were received and three were interviewed. The final cost was $20,000 for 20 days plus expenses. Included were the presentations and a report documenting findings and recommendations.

Preliminary Work Prior To The Consultant Visit

We realized that in order to keep consultant cost to an absolute minimum, significant preliminary work would need to be completed. For example, it would be a waste of money to pay a consultant to locate possible wiring closets when we knew the campus backwards and forwards. Using this concept as a guide, we scheduled a first meeting with the consultant immediately after the contract was awarded to detail exactly what we could do prior to the consultant's visit.

At this meeting we also planned a series of interviews with key faculty, staff and administrators. It was important for the consultant to connect with the campus community in such a way that would enable them to measure user needs and perceptions against those provided by computer services. A kickoff meeting was also planned to occur on the first day of presence on the campus by the consultants. At the meeting, the consultants would introduce themselves to most of the mid and upper level management staff and would describe the project, how they would go about gathering information and what they expected to deliver at the conclusion of their work. Most importantly, this presentation offered another opportunity to educate the college community about the project and create a sense of excitement and feel good about the college moving into this higher level of technology.

The initial meeting with the consultant also resulted in the do list of work to be completed before they came to campus. This was a major effort and could be compared to an in-depth self analysis such as prior to an evaluation. It could be argued that the most important part of the consultant effort was really what we found out about ourselves from the self analysis. We set about accomplishing the following:

* CONDUCT A MANHOLE AND CONDUIT SURVEY - The campus dates back to 1956 and has evolved one building at a time. The physical plant department, while being helpful, did not have near the level of detail that was needed. We began by walking the campus and opening each manhole and documenting the conduits entering and leaving the manhole. Conduit size was listed. The numbers and types of cable in each conduit was listed.

Building codes require that telephone and data conduits and manholes contain NO power. This simplified our study as we did not have to consider any manholes that contained power.

Each conduit was numbered in bright yellow paint and charted using a CAD program. Conduits were included and a topology was drawn. See ATTACHMENT B.

The purpose of the study was to develop a plan that would hopefully eliminate the digging of any new conduits or the placement of any new manholes. Such work would rapidly escalate the cost of fiber and should be minimized if at all possible. The study and topology map also helped to point the designer in the direction of a cabling topology that optimized the physical layout of conduits.

The study disclosed some good news and some bad news. Two conduits were found that connected major parts of campus that had not been used in years. In fact, the telephone cables that were in them were cut off at both ends! We contracted to pull out the old cables and presto, the consultant helped us visualize a ring around campus that provided a natural path for redundant links to each wiring closet.

Another find was a tunnel system that connected the buildings on the main quad. For some reason, this tunnel was not used by physical plant for power or telephone, relying instead on exterior conduits. Needless to say, we took it over and it saved many dollars in trenching and provided easy access to wiring closets in a number of the main buildings.

The bad news was that we determined that a number of conduits were completely filled with telephone, coax data cables and twisted pair data cables and control system cables (fire, energy management, TV, etc.). Fortunately, the entire network project required minimal construction: a 110' conduit to connect an existing duct bank to a tunnel beneath the main buildings; two 100' conduits to link the main

technology building (the computer center) with the building immediately adjacent; and a 50' conduit to connect a building to an adjacent manhole.

Thanks to the level of effort accomplished to develop alternative paths and to work with what was available, only about $ 50,000 was expended for extra trenching and conduits. We were very pleased.

* INTEGRATE THE CAMPUS 10 YEAR MASTER PLAN - Perhaps it should go without saying, but obtain a copy of your master plan to be sure that any trenching you do need to do will not be right in the way of some projected construction. Future campus growth plans also serve as useful information in planning for extra fiber. Its cheaper to do it now. See ATTACHMENT C.

* DOCUMENT EXISTING LANS - If your campus is like ours, chances are that major offices, departments and lab facilities will not move beyond reason. So start with the existing LANs and you will have a good idea where major computing needs will be in the future. Design your fiber topology with this in mind. Take your existing connectivity needs and double them, then double that and you will have a fine plan.

* DETERMINE POSSIBLE WIRING CLOSET LOCATIONS - Using Category 5 unshielded twisted pair as the standard, we walked the buildings with a pass key and determined where wiring closets could be located that were always within about 300 feet of each workstation. It was our intent to home run each cable directly from the closet where hubbing equipment would be located to each workstation. This makes for the simplest design with minimum possible points of failure. Be ready to negotiate with area managers and building maintenance to obtain the space you need. See ATTACHMENT D.

* DEVELOP WIRING STANDARDS - We wanted to have the upper hand in dealing with fiber and copper wiring contractors. We contacted other major institutions and organizations in our area that had been installing networks and asked for their wiring standards. From these we assembled a set of standards that would fit for us. We defined cable types, connector types, cabinetry, plenum cabling, in-wall vrs. surface mount wiring and everything else we could think of. Then when it came to dealing with contractors we knew exactly what we wanted. See ATTACHMENT E.

Developing The Request For Quotation

As was stated earlier, we did not have the funds to afford a consultant to write the RFP. But when we really got down to it, we didn't want a consultant to do it. It was to be our network and if we couldn't define what we wanted, well .....

First let me state that during the time we were selling the project to the campus, preparing for the consultant, etc. (about a six-month period), we were attending every free seminar we could get to and were entertaining every hub and router vendor, installer and reseller on the campus that we could locate. We were building up our level of expertise so we could prepare the RFP and later evaluate the responses.

The RFP turned out to be 19 pages with five attachments. The document was broken down into five sections titled General Information and Network Description (including the vendor selection process), Fiber Cabling and Termination Equipment, Network Concentrators and Hubbing Equipment, Router Equipment and a Composite Cost Section.

Requests for Quotation were forwarded to 33 prospective suppliers - a list that we had accumulated over many months. Vendors included resellers, manufacturers and catalog suppliers of all sizes. Responses were received from 11 vendors. All major industry suppliers responded including Chipcom, Synoptics, Cabletron, Hughes, Lannett, 3COM, Cisco, Wellfleet and others.

Quotations ranged from $460,943 to $580,035. An important provision included in the RFP stated that we expected to negotiate a final contract price with our vendor of choice AFTER the vendor was chosen. This provided us with a level of flexibility that we needed so we could react to changes in college needs and in the industry between the time the RFP was prepared and Board of Trustee approval was granted - about three months. It also enabled us to have squirming room in selecting the best fit for the college. The final contract amount was $513,000.

In order to qualify for submitting a bid, vendors had to attend a pre- bidders conference where attendance was verified. After the meeting, vendors were split into groups and all campus buildings were walked.

Vendor Selection Process

Vendor selection and award of contract was based on a number of criteria including a point evaluation process. This process helped to insure that the college obtained the best equipment available for use now and in preparation for the future. Also of importance, was the objective of forming a business partnership with a vendor(s) who was capable of and interested in providing continued service to the college.

* SELECTION CRITERIA POINTS

* TECHNICAL QUALITY of the PROPOSED SOLUTION 40

Of interest was the vendor response to the specifications already developed; creative ideas in the proposal to refine and improve the specifications; hardware architecture; vendor plans for the future; how the response fits in with the college's stated directions.

* VENDOR QUALIFICATIONS 30

Vendor reputation; experience as an integrator or demonstrated ability to work with other vendors; time in business; references in the local geographical area; financial stability; key personnel to be involved; perceived desire to service the college.

* PRICE 20

Compared the firm fixed price of the various proposals. In the event technical proposals and vendor qualifications were similar, price may be a major factor. A contract would not be awarded solely on the lowest price.

* COMPLETENESS OF VENDOR RESPONSE 10

Content and quality of the vendor response to this RFP; adherence requested proposal format; understanding of needs and limits.

* TOTAL POINTS 100

Two vendors totaled in the mid-80's in points with the rest of the pack in the 70's. Negotiations occurred as we sought to find the strengths and weaknesses in the vendor approaches. Finally, one vendor stood above the rest and a proposal was sent to the Board of Trustees.

What Specific Criteria Was Used In The Final Selection

In the final analysis, vendor selection was based on a number of criteria that surfaced in discussions among the team members:

The desire for a single source of supply for the fiber installation, the hubbing equipment and the routing equipment was important to us. We wanted one organization to be held accountable for the entire project. They would then be responsible for marshalling their suppliers.

We looked for resellers with a strong local presence and commitment to our geographic area. We wanted a company with adequate financial backing to offer us payment options. Local references, and perhaps some in higher education networks would be a strong plus.

It became obvious during the negotiations that some companies above others offered a responsive sales force that could anticipate our questions and needs.

For the hubbing and routing equipment itself, we wanted a company with financial strength and past history that suggested they would play a major role in the future and perhaps even participate in defining it.

Equipment architecture became important. We wanted flexibility in equipment offerings where we could select chassis hubs or stackable hubs depending on the concentration of users at a particular location. We did not want a stackable choice to limit us in terms of network management or migration to newer technologies when available. We also wanted a chassis hub solution that could be installed in areas beyond the central computer center. Chassis hubs offer the highest level of flexibility and connectivity but they had to be affordable.

Hub density was a factor. We wanted to install chassis hubs that were sufficiently robust so that connecting more workstations in a given area could be accomplished incrementally without obsoleting equipment.

Since we had a historical commitment to and comfort level with token ring, we wanted to work with a company with the same level of commitment. We did not want to see token ring products always brought out last. We wanted to see a switchable token ring plan in place.

For the routing solution, we were looking for a scaleable plan that would provide sufficient bandwidth to incorporate all of our current and planned future rings in one chassis. Backplane speed had to be very robust. We also were interested in a solution that recognized the collapsed backbone philosophy as an ideal connectivity solution. Router options were also important as we expected to install a separate physical router as our Internet link, we had two remote sites with multiple rings currently installed now and we of course had the main computer center. The product line needed to be sufficiently broad to offer price competitive solutions to meet these three different scenarios.

The college had already made a commitment to Netview/6000. We wanted a hubbing and routing vendor that fully incorporated this product within their network management strategy. We also wanted a graphical display of the physical devices that would be able to integrate with Netview. Optimally, we hoped for a graphical product that would be identical for both the hubbing and routing devices.

And of course price. We wanted a vendor that was willing to fight for our business and offer price alternatives and concessions as necessary in order to win the project. During the negotiation we were looking for design modifications that would minimize cost but still meet technical needs. We were not willing, however, to buy second rate equipment just because it was the least expensive.

The final choice for the college was a solution offered by Bay Networks, the company resulting from the merger of Synoptics and Wellfleet. The local reseller and integrator was Data Systems Marketing, a $60 million company in the Baltimore suburban area.

Integration Plans

The installation of a fiber network for the college was not meant to be a revolution. The network design was thought to be an evolution from the current level of technology that would leverage the existing design and installation to provide increased support, network flexibility and future capability.

Since we have been building a collapsed backbone architecture for several years, we saw the fiber network as a means of connecting the workstation rings in campus buildings to central servers in a high speed network that would increase functionality and provide a new level of interconnectivity.

It was also our plan to build a network that would improve uptime and be manageable from a control standpoint - we wanted to know what was going wrong before it went wrong. This presumed using non-passive hubbing equipment and intelligent routing for all future purchases.

Prioritizing equipment purchases enabled us to select areas of the college that had a high immediate need. Hubbing equipment and routing support was purchased for these first. Since our major opportunity was to interconnect LANs, we did not plan to replace any existing LAN cabling or passive multi-station access units at first. We acquired sufficient equipment to connect the existing category 5 and Type I LANs to the hubs. For several new areas, we did acquire sufficient hubbing gear to home-run these installations directly to the hubs (our standard for all future connectivity schemes).

This enabled us to bring up the network with a rather small initial investment but let us take advantage of much of what was anticipated for the future.

We are now at the point of installing the hubbing equipment in the closets and connecting to centralized routing. Hopefully, all will go according to plan and we will meet out goals.

Enhancing The View Of The Future

As the project has evolved, so have our expectations. Industry developments have also suggested some exciting future uses of the new network that would not have been possible before. Our list is still growing but for now, it includes:

- College-wide access to the production duplicators for faculty and staff so that documents can be transmitted via the network and held in a queue in the copy center for duplication.

- Access from any student lab to all student software existing anywhere even when some buildings or labs are closed.

- A robust Mosiac access to the World Wide Web.

- A network with bandwidth to handle imaging. Under consideration is an option to outsource imaging and link the off-campus supplier to user offices via the network.

- Using the network as an enabler for maintaining a software and hardware inventory, a software distribution system and a means of automating server and workstation backups.

- Establishing a college-wide directory of files with standards in place on all machines.

- A new awareness that client-server computing depends first on a high bandwidth network.

- A potential for a PC administrative application to be accessible from any location with no degradation of response.

- Centralizing dial-out activity and FAX service for all PC users.

AND IN CONCLUSION ....

Thank you for your attention and I have time for any questions you may want to ask.